REMARKS/ARGUMENTS

Reexamination and reconsideration of this application as amended is requested. By this amendment, claims 1, 3, 5, 8, 10, and 13-14, have been amended, claims 6, 12, 15, and 17-20 are cancelled, and new claims 21-23 have been added. Claims 1-5, 7-11, 13-14, 16, and 21-23 remain in the application.

EXAMINER INTERVIEW

A telephone interview was conducted on 14 December 2004 between Examiner Mayekar, inventor Ken Dean, and the undersigned, William Koch, Registration number 29,659. Items discussed included two typos where it was considered that the printing made some letters look alike, the issue of "consisting of" regarding claims 6 and 15 wherein it was stated the two claims might be made independent so the additional element could be added, and the references Russ '467 and Jin '697. No agreements were reached.

OBJECTION TO CLAIMS 1, 3, AND 13

Claims 1, 3, and 13 have been objected to because of informalities.

The Examiner has objected to the word "disposod" in line 4-5; however, Applicant's copy of the specification shows the word as "disposed". Furthermore, a word search did not reveal "disposod" anywhere in the specification. Therefore, it seems improper to make said amendment. If the Patent Office's copy shows the word as "disposod", would the Examiner please make an Examiner's amendment to correct same. During the interview, it was mentioned that the Examiner's printed copy contained similarly looking o's and e's.

Additionally, the Examiner has objected to the typo "a solvont" in claim 6. During the interview, it was concluded that the word appeared in claim 3, not claim 6; however, Applicant's copy of the specification shows the word as "solvent". Again, it seems improper to make said amendment. If the Patent Office's copy shows the word as "solvont" in any location, would the Examiner please make an Examiner's amendment to correct same.

The remaining typo errors addressed by the Examiner have been corrected.

Accordingly, it is believed that the objection to claims 1, 3, and 13 has been overcome by the amendment and remarks.

REJECTION OF CLAIMS 1-11 AND 13-16 UNDER 35 U.S.C. §112

Claims 1-11 and 13-16 have been rejected under 35 U.S.C. 112 as being indefinite.

Claim 3 has been amended to remove both instances of "having a solute disposed therin".

Claim 5 has been amended to clarify the description of the colloidal solution.

Claim 6 has been cancelled and a new independent claim 21 has been added that includes the limitations of claims 1 and 6.

Claim 8 has been amended by deleting "a" in front of "plurality of emitting structures" and replacing with "the".

Claim 10 has been amended to remove both instances of "having a solute disposed therein".

Claim 12 has been cancelled and a new independent claim 22 has been added that includes the limitations of claims 9 and 12.

Claim 14 has been amended to clarify the "colloidal solution".

Accordingly, it is believed that the rejection of claims 1-11 and 13-16 under 35 U.S.C. 112 has been overcome by the amendment and remarks.

REJECTION OF CLAIMS 1-8 UNDER 35 U.S.C. §103

Claims 1-8 have been rejected under 35 U.S.C. 103 as being unpatentable over Russ (6,462,467) in light of Russ (6,342,755) and in view of Jin et al. (5,977,697).

The standard electrophoretic deposition practice, invented probably more than 70 years ago, is to mix a particle with IPA and a charging agent to set up the suspension. Deposition with this method leaves a non-adherent film. This standard practice is described in Jin (diamond particles in IPA), JP 2001-312955A, and Choi.

The next level of standard practice, also invented probably more than 70 years ago, is to mix a particle with IPA and a charging agent to set up the suspension, and a binder. The binder mixed with the CNTs binds their ends down, removing the emissive property. The typical practice binder is made by adding water to the IPA (reagent grade IPA (American Chemical Society standard) is 99.5% pure with <0.2% water). Note that Russ has 1% to 30% water. The water reacts with the charging salt to form a hydroxide. The addition of water in large amounts reduces adhesion due to H_2 formation (see Russ patents). It also de-stabilizes the solution, causing nanotubes to agglomerate and the fall to the bottom over time, leading to non-uniform film deposition. This standard practice is described in the Russ patent and the Choi patent which appears to contain a solvent with water in it due to the described pre-processing with nitric and sulfuric acids which contain water.

In the present invention, adhesion, uniform deposition, and good field emission properties are obtained by depositing the binder first, then the nanotube layer using a very stable

solution. Consequently there is no binder on the field-emitting end of the carbon nanotubes to blunt the sharp geometry or to otherwise disrupt field emission. The thermal step promotes adhesion between only the nanotube end which is touching the binder layer, thereby leaving the other end free. As an added result, of the present invention, it is possible to fragment the binder layer in the thermal cycle, leading to the formation of edges coated with nanotubes and mechanical separation of nanotubes. These nanotubes have a greater geometric field enhancement and thereby emit more current.

In summary, the present invention teaches applying the binder material in a first solution, then the high aspect ratio emitters in a second solution to improve adhesion of the emitters.

The Russ '467 and '755 references disclose applying the emitters in the same solution as the binder material, which, as Russ admits at column 5, lines 5-21, interferes with the emitters adhering to the substrate.

The Jin '697 reference discloses suspending diamond like particles in a solution comprising water, alcohol, or acetone and applying onto a substrate. A conformal diamond over-coating layer is placed over the diamond like particles.

There is no suggestion or basis to combine the Jin reference with the Russ references. To justify combination of references, it is necessary not only that it be physically possible to combine them, but the art should contain something to suggest the desirability of doing so. Ex parte Walker, 135 USPQ 195 (POBA 1961). It is not physically possible to combine the Russ references and the Jin reference. They deal with two separate technologies. Jin deals with diamond like particles, while Russ deals with carbon nanotubes. The two technologies deal with different issues and generally use different processes to overcome these issues. Though Jin

suggests applying the diamond like particles in a solution of alcohol, he also mentions water, and does not seem to recognize any issue associated with the placement of high aspect ratio carbon nanotubes. Furthermore, Jin applies a conformal overcoating 54 on the diamond like particles 53 to increase the bonding. This overcoating completely eliminates the field emission property of high aspect ratio emitters because it pins down, or conformally coats, the free end, eliminating the geometrical field enhancement (note in the present invention it is stated on page 10, lines 6-8 that "...having carbon nanotubes embedded in edges 42, 43, and 44 of micro-islands 40 and protruding from edges 42, 43, and 44."(underlining added)). Therefore, there certainly is no suggestion to combine the references.

Furthermore, another key difference is that the primary advantage of the two step process of the present invention is that the prior art (binder in with the nanotubes) causes the nanotubes to agglomerate and produce a non-uniform coating. The second paragraph of the background section for the pending Application discusses the problem of the prior art method having nanotubes which agglomerate and fall out of suspension. Both Russ and Jin describe standard practice electrophoretic deposition techniques well-know in the art. They fail to consider that the special chemistry of nanotubes causes them to fall out of suspension when using their processes.

More specifically, claim 1 teaches immersing the substrate into the binder solution so a binder forms thereon, then immersing the substrate into a suspension bath consisting of an alcohol and the high aspect ratio emitters (no binder material in the suspension). This process differs from the Russ process (both references) and also the Jin reference for the reasons given.

Claims 2-8 are believed allowable at least since they depend from claim 1, and for the additional restrictions they add to claim 1.

Accordingly, it is believed that the rejection of claims 1-8 under 35 U.S.C. 103 has been overcome by the amendment and remarks.

REJECTION OF CLAIMS 9-11 AND 13-16 UNDER 35 U.S.C. §103

Claims 9-11 and 13-16 have been rejected under 35 U.S.C. 103 as being unpatentable over Russ (6,462,467) in light of Russ (6,342,755) and in view of Jin et al. (5,977,697) and Choi et al. (6,616,497).

The Choi reference discloses using a suspension of nanotubes and a surfactant such as Tritron Z-100 and $Mg(OH)_2$. This suspension is similar to the suspension in Russ wherein the binder material interferes with the emitters adhering to the substrate. The combination of these patents either yields art with a suspension of nanotubes with a surfactant ($Mg(OH_2)_2$) without water), which then contains no binder, and consequently does not adhere well to the substrate, or nanotubes plus a surfactant plus enough water to use $Mg(OH)_2$ as a binder, in which case the nanotubes fall out of solution. The combination of these patents does not address the stability of the solution, nor does it solve the problems (concurrent adhesion, solution stability and uniformity, and field emission properties) of claims 1-8 and 9-11 and 13-16.

Since the Choi reference process is similar to the Russ process, the reasons presented above regarding claims 1-8 apply equally well for claims 9-11 and 13-16.

More specifically, claim 9 teaches immersing the substrate into the binder solution so a binder forms thereon, then immersing the substrate into a suspension bath consisting of an alcohol and the high aspect ratio emitters (no binder material in the suspension). This process differs from the Russ process (both references) and also the Jin reference for the reasons given.

Claims 10-11 and 13-16 are believed allowable at least since they depend from claim 1, and for the additional restrictions they add to claim 9.

Accordingly, it is believed that the rejection of claims 9-11 and 13-16 under 35 U.S.C. 103 has been overcome by the amendment and remarks.

REJECTION OF CLAIMS 9-11 AND 13-16 UNDER 35 U.S.C. §103

Claims 9-11 and 13-16 have been rejected under 35 U.S.C. 103 as being unpatentable over Russ (6,462,467) in light of Russ (6,342,755) and in view of Jin et al. (5,977,697) and JP 2001-312955A.

The JP reference discloses a photoresist (polysilane - see page 8, paragraphs [0056 of the computer translation] and [0057]), mixed with carbon black conductor, is first deposited as a binder material using a spin-coating [0057]. The nanotubes are then deposited on the photoresist by electrophoretic deposition. A baking step promotes adhesion to the nanotubes and somehow removes the photoresist which was not exposed to light during the photo-step.

The present invention is different from the JP reference in that the present invention uses EPD of the binder, uses a vacuum compatible binder (does not require burning off used binder), and forms microislands. The JP reference does not address keeping nanotubes in suspension or producing a uniform deposition of nanotubes.

More specifically, claim 9 teaches immersing the substrate into the binder solution so a binder forms thereon, then immersing the substrate into a suspension bath consisting of an alcohol and the high aspect ratio emitters (no binder material in the suspension). This process differs from the Russ process (both references) and also the Jin reference for the reasons given.

Claims 10-11 and 13-16 are believed allowable at least since they depend from claim 1, and for the additional restrictions they add to claim 9.

Accordingly, it is believed that the rejection of claims 9-11 and 13-16 under 35 U.S.C. 103 has been overcome by the amendment and remarks.

CONCLUSION

The remaining cited references have been reviewed and are not believed to affect the patentability of the claims as amended.

No amendment made herein was related to the statutory requirements of patentability unless expressly stated; and no amendment made herein was for the purpose of narrowing the scope of any claim, unless Applicant has argued herein that such amendment was made to distinguish over a particular reference or combination of references.

In view of Applicant's amendments and remarks, it is respectfully submitted that Examiner's rejections have been overcome. Accordingly, Applicants respectfully submit that the application, as amended, is now in condition for allowance, and such allowance is therefore earnestly requested. Should the Examiner have any questions or wish to further discuss this application, Applicants request that the Examiner contact the Applicants attorneys at 480-385-5060.

Appl. No. 10/024,164
Amdt. Dated 3 January 2005
Reply to Office action of 4 October 2004

If for some reason Applicants have not requested a sufficient extension and/or have not paid a sufficient fee for this response and/or for the extension necessary to prevent abandonment on this application, please consider this as a request for an extension for the required time period and/or authorization to charge Deposit Account No. 502,091 for any fee which may be due.

Respectfully submitted,
INGRASSIA FISHER & LORENZ

Dated: 3 Jan 2005

By _____
WILLIAM E. KOCH
Reg. No. 29,659
(480) 385-5060
bkoch@ifllaw.com